

Exhibit I

Learning Through Alliances: GENERAL MOTORS AND NUMMI

Andrew C. Inkpen

In recent years, companies have often touted the learning opportunities created by their strategic alliances. Alliances, the argument goes, bring together firms with complementary skills. Alliances can provide a window into the skills and knowledge of other firms and create a powerful tool for learning. By working closely together, partner firms can gain access to the best practices of their partners and then transfer the practices back to the parent organization.¹ In an interview a few years ago, BP CEO John Browne discussed the value of learning through alliances and stated, "Any organization that thinks it does everything the best and need not learn from others is incredibly arrogant and foolish."²

There is no question that many firms enter alliances with learning objectives. In reality, however, learning through alliances is very difficult. Although alliances often create valuable learning opportunities, the exploitation of the opportunities is a difficult, frustrating, and often misunderstood process.³ More often than not, firms learn little from their alliance partners. There are various reasons why learning does not occur: the partner's knowledge is not properly understood; the intended recipient rejects the knowledge; the transfer mechanisms are inappropriate for the type and scope of knowledge; or insufficient resources are applied to the learning task.

Nevertheless, some alliances do yield valuable learning. General Motors (GM), the world's largest automaker and a firm often criticized as staid and wedded to old ideas and practices, has exploited the learning opportunity created by NUMMI, its California-based alliance with Toyota. Over the past few decades, GM has steadily and significantly improved its quality and productivity. A key factor in this improvement has been knowledge transferred from Toyota to NUMMI and NUMMI to GM. Senior executives at GM acknowledge that NUMMI has been at the forefront of the firm's efforts to adopt lean manufac-

turing. According to Gary Cowger, GM VP manufacturing and labor relations, "The roots of our improvement are in the Toyota Production System [TPS]. We learned from them [Toyota]. We've got to give credit where credit is due."⁴ An executive, interviewed for this study, referred to NUMMI as the "guiding light for the improvement in GM manufacturing quality." Another senior executive, Mark Hogan, said, "NUMMI has become the centerpiece of GM's efforts to adopt lean manufacturing, the practice of reducing inventory and other costs to minimal levels."⁵

In exploiting the NUMMI learning opportunity, the GM experience shows that not only is it possible to learn from an alliance, the learning can be the basis for major skill upgrading. In this article I describe how GM transferred the "sticky" knowledge⁶ of NUMMI to the initially skeptical GM manufacturing community. To develop the article, I interviewed more than 45 current or former GM managers and visited NUMMI and various other GM plants. For a detailed discussion of the research methods, see the Appendix.

With NUMMI, GM was faced with a complex alliance learning situation. For successful learning to occur, GM had to develop a new way of manufacturing that involved a complex set of organizational factors. The knowledge obtained from NUMMI spiraled its way through the GM organization and supported development of world-class manufacturing facilities in various locations, including Eisenach, Germany; Rosario, Argentina; and Lansing, Michigan. The knowledge also allowed GM to develop new insights into Toyota's strategy, organization, and operating systems, something that would have been much more difficult without NUMMI. Over time, GM put a variety of learning mechanisms in place and a systematic approach to alliance learning and knowledge transfer emerged. These mechanisms include managerial assignments to NUMMI, visits and tours to NUMMI, a technical liaison office for managing learning activities, leadership commitment and involvement in the learning process, and a learning network to articulate and spread the knowledge.

Andrew Inkpen is the J. Kenneth and Jeanette Seward Chair in Global Strategy at Thunderbird, The Garvin School of International Management.

Background

Why are so many firms unable to exploit alliance learning opportunities? Gaining access to partner knowledge is not usually the problem for alliance partners. The primary obstacle is a failure to create the specific organizational processes necessary to acquire, assimilate, and disseminate alliance knowledge. In other words, organizations do not know how to create a successful alliance learning environment and overcome knowledge transfer barriers. More specifically, most alliance learning experiences are characterized by one or more of the following problems.

- **Causal Ambiguity**—Firms often fail to understand or appreciate their partner's areas of competency, a situation that has been referred to as causal ambiguity.⁷ Causal ambiguity arises when managers do not

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understand the relationship between organizational actions and outcomes. A common expectation in the alliance context is that the knowledge associated with differences in skills between the partners will be visible and easily transferable. Many firms have expected to find knowledge in their alliances that could be easily transferred on a piecemeal basis. Often these firms formed their alliances with an objective of learning *what* their partner knew, rather than *how* and *why* the partner firms knew what they knew. Once they learned more about their partners, they realized that the most valuable knowledge was deeply embedded in an overall philosophy of doing business and tied to the culture and values of the partner firm. Once a firm realizes that alliance knowledge is more complex than expected, there is a tendency to conclude that the learning effort is simply too difficult and not worth a major investment in knowledge management.

- **Leadership Commitment**—Top management's role in organizational learning should be one of catalyst and architect. While multiple advocates are important, there must be at least one strong champion of learning in a leadership position. The leader's role is especially important in initiating linkages between parent and alliance strategies. Unfortunately, managers and leaders without direct involvement in the alliance management or its operation often do not appreciate the deeper meaning of the differences in skills between the alliance and the parent and, hence, discount the learning opportunity. More than a decade ago, Hamel and colleagues identified a problem that still exists in alliances: leaders are often obsessed with alliance ownership and structural issues while discounting the alliance learning opportunities.⁸
- **The Cost of Learning**—To learn through alliances it is not sufficient to merely expose individuals to new knowledge; the intensity of efforts applied to the learning is also critical. Unfortunately, many companies are unwilling to incur the expense of setting up learning-oriented systems, such as sending key parent managers to the alliance on a regular basis to experience the alliance first-hand. In one case, the Japanese partner sent dozens of engineers to the joint venture for short-term assignments with no clearly defined tasks, leaving the American partner wondering how the Japanese partner could afford it. From the Japanese partner's perspective, the value of the learning more than compensated for the cost of the engineers. Given the sometimes haphazard and idiosyncratic nature of alliance learning, firms may view resources committed to learning as extravagant, wasteful, and not directly associated with successful alliance management. However, you get what you pay for and if no investment in learning is made, learning will not occur.
- **Individual Managers as the Learning Conduit**—Learning through alliances starts with the individual managers who have direct exposure to the alliance operation. These managers are often assigned to the alliance for a specified period of time after which they will return to the parent

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organization. Although these managers are expected to be knowledge brokers, all too often they are rotated back to the parent and their unique insights fall on deaf ears.⁹ The problem is that these managers are expected to share knowledge but are often inadequately prepared for their re-entry to the parent. The recipient units often do not know how to take advantage of the rotated managers. The result is that learning dissipates as individuals find themselves unable to influence organizational change in the parent. Quite often these managers become frustrated and leave the organization, perhaps to join a competitor or even the alliance partner.

- **Not Invented Here Syndrome**—Finally, the classic problem of the Not Invented Here Syndrome can derail an alliance learning experience. Parent company managers are often threatened by the learning occurring in their alliances and by the managers assigned to work in the alliance. The result is that parent managers often discount the value of the learning potential and make statements such as “What they do in the alliance does not apply here. The alliance is in a different business.” The parents may have difficulty accepting the alliance child, a new organization with limited experience, as a legitimate teacher. Rover, a failing U.K. car company, formed its first alliance with Honda in 1980. Although Rover came to rely heavily on Honda for technological support, the company had no strategy for learning until 1991, which by then was too late. The entrenched culture in Rover ultimately meant that a valuable learning opportunity was squandered.

NUMMI and General Motors

Negotiation and Formation of the Alliance

In 1982, GM and Toyota began negotiating a 50:50 equity joint venture to assemble small cars in the United States. After a year of negotiations (led by Jack Smith, GM's chairman from 1996-2003), the two companies announced a partnership based at GM's plant in Fremont, California, which GM had closed in 1982 after being plagued for years by labor and quality problems. Toyota contributed \$100 million and GM provided the plant (valued at \$89 million) and \$11 million cash. The companies also raised \$350 million to build a metal stamping plant. For Toyota, the main alliance objective was rapid U.S. market entry to counter Honda and Nissan and to alleviate trade friction between Japan and the United States. Toyota was also interested in learning to work with an American workforce. The primary goals for GM were sourcing a small car and utilizing an idle plant. Learning from Toyota was a goal of GM's Chairman Roger Smith but was not clearly formulated or widely shared within the GM manufacturing organization.¹⁰

NUMMI began operating in 1984. Toyota was given overall operating responsibility for the plant and product design. The first CEO was Tatsuro Toyota, son of the founder of Toyota. The chief operating officer also came from

Toyota and the general manager from GM. The joint venture agreement allows GM to assign up to 16 managers to NUMMI (the actual number has sometimes been higher). These managers work in various different areas, including human resources, finance and accounting, engineering, and purchasing. A number of managers also have been hired from outside GM and Toyota. One of the most important early decisions by GM and Toyota was to seek a different union agreement with the United Auto Workers. The union agreed to the adoption of the Toyota production system with its flexible work rules and broad job classifications.

GM has been able to use NUMMI as a source of knowledge in the assembly area and there has been a real and effective knowledge transfer. That said, GM was very slow to capitalize on the learning opportunity. NUMMI has provided GM with important insights into Toyota's competitive strengths but because activities such as product development and engineering are outside the scope of NUMMI, GM's learning opportunities have been primarily in the manufacturing and assembly area.

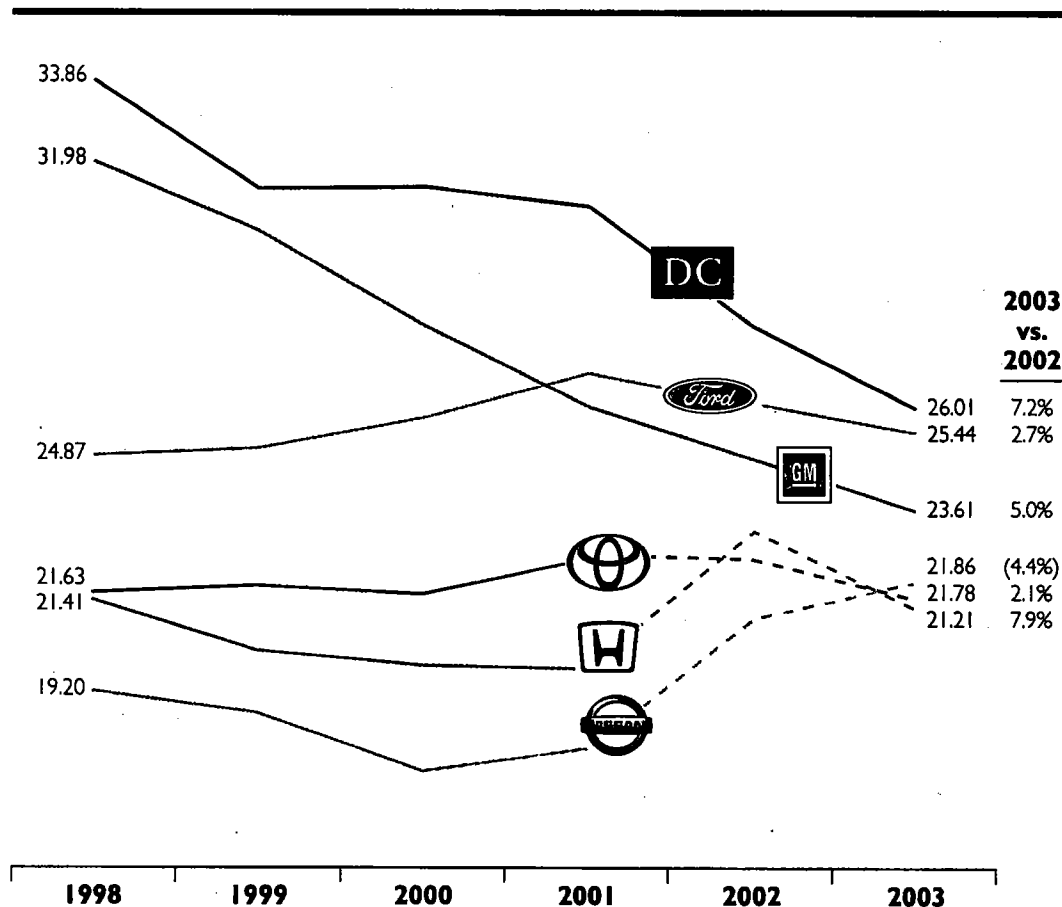
In 2004, the NUMMI plant continued to be an important source of small cars for both parents. In 2003, NUMMI built 395,000 vehicles, the most in its history. Employment in the plant in 2004 was at its highest level ever (about 5700) and three vehicles were being manufactured: two cars—Toyota Corolla and Pontiac Vibe and the Toyota Tacoma pickup truck. Plant operations include plastics, stamping, body and weld, paint, and assembly.

The Learning Impact

Over the past few years, GM has significantly improved its quality and productivity. In 2002, GM surpassed Ford for the first time in the 13-year history of the influential Harbour Report's annual study of North American auto-plant productivity. In 2002, GM became the first American carmaker to rank in the top three of the J.D. Power and Associates' annual Initial Quality Study, which measures customer complaints in the first 90 days of ownership. Exhibit 1 shows GM's improvement in labor productivity over the past five years in comparison to its major competitors. GM also narrowed the gap between its quality ranking and that of Honda and Toyota, the perennial North America quality leaders. In the J.D. Power report, GM had the top three positions for North American plant quality and the top ranked plant in South America. GM executives have publicly identified one of the factors in their own improvement as learning from NUMMI. According to one executive, "NUMMI has become the centerpiece of GM's efforts to adopt lean manufacturing, the practice of reducing inventory and other costs to minimal levels." Learning from NUMMI has had an impact on GM. However, that learning did not occur easily or quickly. Many GM executives were initially skeptical of the learning opportunity and it took almost a decade before a real learning system began to emerge.

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EXHIBIT I. GM Assembly Labor Productivity—Hours per Vehicle



Source: Data from Harbour Consulting; GM excludes medium duty vehicles; Honda, Nissan, and Toyota 2002 data includes Harbour.

The Learning Trigger for GM

As soon as the joint venture began operating, NUMMI's productivity relative to other GM plants produced comparative data that demonstrated the significant differences between GM and Toyota.¹¹ GM produced various internal studies designed to identify the reasons for NUMMI's superior productivity and educate the company's leadership. One GM study done in 1985 found that "the result of the Toyota approach is products of superior quality produced with significantly fewer human resources (40%) and lower investment (30% to 50%) than at comparable GM facilities." The initial managers (i.e., the advisors) assigned to NUMMI quickly realized that the Toyota Production System (TPS) was different and potentially valuable for GM, which meant that NUMMI assignments developed into unique personal learning experiences. A GM manager who worked at NUMMI in the 1980s described the experience as "a feeling of zealotry. What we were seeing was so much better, so much easier, and so

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much more effective than in GM. We thought that surely GM would see the light. We knew that NUMMI could have a profound effect on GM."

GM's Initial Struggles With Learning

GM's attempt to transfer knowledge in the mid-1980s was driven by the realization that NUMMI was outperforming comparable GM plants. However, the first few waves of advisors moved from NUMMI to GM were largely unsuccessful in their efforts to transfer knowledge. One problem was that managers assigned to NUMMI in the early years of the joint venture were given little preparation or training for their assignment. One manager sent to NUMMI in 1986 had one month to prepare and was told by his boss in Detroit to "learn as much as you can." When these managers' assignments were completed, normally after two years, they were expected to return to GM to share their experience. However, although the NUMMI advisors were learning as individuals, many became frustrated when they re-entered GM because they were unable to implement the ideas they had learned from NUMMI. This difficulty with implementation was driven by two factors. The first was significant resistance within GM and a lack of understanding as to how GM could benefit from lean manufacturing. Although some GM executives saw an opportunity to learn from Toyota, many senior managers were opposed and even resented the idea of collaborating with a Japanese company. These managers were essentially in denial, attributing the Japanese automakers success to unfair competition (low value of the yen, government support in Japan, and so on) rather than better management. Under these circumstances, which persisted until about 1992, system-wide learning was impossible.

The lack of understanding and appreciation for the value of NUMMI knowledge ties back to the discussion of causal ambiguity. Knowledge cannot be appropriately valued if it cannot be understood. Knowledge associated with the TPS was particularly difficult to understand because of its systemic and integrated nature, which leads to a second factor impacting the implementation of NUMMI ideas. Within GM there was a belief that the "secret" to the TPS was observable and transportable, i.e., "if we could just get the blueprints for stamping." However, the knowledge was not easily broken down into transportable pieces. The knowledge about the TPS and lean manufacturing was deeply embedded in the Toyota context and was tied into an integrated system.¹² As a manager said, "You cannot cherry pick elements of lean manufacturing; you must focus on the whole system. Once you learn how the system works you need a good understanding of the philosophy that underpins it." The initial learning challenges are summed up in the following statement from a GM manager:

"We [managers in GM] started with denial that there was anything to learn. Then we said Toyota is different, so it won't work at GM. Eventually we realized there was something to learn. The leaders initially said: implement lean manufacturing, but they did not understand it. . . We went to Japan and saw *kanban* and *andon* but people did not understand why they work. We did not understand that the

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TPS is an integrated approach and not just a random collection of ideas. . . We implemented parts of the system but did not understand that it was the system that made the difference. . . We did not understand that the culture and behavior had to change before the techniques would have an impact."

By the mid- to late-1980s pockets of support for using NUMMI as a learning vehicle were emerging within GM. However, the North American manufacturing organization was largely opposed to a joint venture with Toyota and was confident in its own abilities. Many advisors who were moved to such an environment found that they had limited influence on the beliefs and norms of the new GM unit to which they were assigned. Those that were able to make an impact had to persevere and accept that in the early days of learning from NUMMI, implementation of lean ideas would mean limited recognition and rewards.

There were other learning missteps. From 1990 to 1995 GM did extensive videotaping of NUMMI operations with the expectation that the videotapes could be used to illustrate the TPS. The problem was that the videotapes could only show how the TPS worked and not why, which meant only surface learning could happen. GM also tried to quickly implement some of the obvious TPS elements, such as *andon* systems. An *andon* refers to the warning lights on an assembly line that signal work center status. In the *andon* system the operator can signal the team leader when there is a problem. The worker pulls the cord once to sound an alarm to get the team leader's attention. If the cord is not pulled again within 60 seconds, the line will stop. For GM, the idea of allowing line workers to stop the line was revolutionary. In trying to implement *andon*, GM initially failed because they did not understand the non-visible processes that supported *andon*, such as standardized work, team member systems, and problem solving.¹³ As one former plant manager said, "I was not successful in implementing *andon* because we did not really understand what it would take to make it work." Whereas GM interpreted the *andon* system as "when you pull the cord the line will stop," Toyota developed *andon* so the operator could get help when needed and to ensure the line kept moving at the optimal speed and to ensure that problems were solved when they occurred. Only rarely will the entire assembly line stop at Toyota, whereas GM initially saw *andon* as problematic because it could lead to line stoppages, which in the mass production mentality is the worst thing that can happen. Ironically, GM initially focused on TPS elements associated with visual control (such as *andon*) because the elements were visible and obvious to anyone seeing the TPS for the first time. However, the key lessons of the visual control elements were not visible and required deep understanding of the TPS.

A Learning System Emerges

In 1992, a pivotal event occurred. Jack Smith was appointed as CEO and played a key role in changing the leadership orientation towards NUMMI. Jack Smith headed the GM negotiating team when NUMMI was formed and understood that the joint venture created a major learning opportunity. Smith became

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the head of European operations in 1987, vice chairman for international operations in 1990, CEO of GM in 1992, and chairman in 1996. In Europe, Smith built a team of colleagues that recruited people who understood lean production, many of whom who had experience in NUMMI (see sidebar on NUMMI and Greenfield Plants). With Jack Smith as CEO, learning from NUMMI became a priority for GM (although vestiges of the denial lingered on for years). The following describes the key mechanisms that supported learning and knowledge transfer.

The Technical Liaison Office

In 1985, GM created the NUMMI Technical Liaison Office (TLO) in Fremont. The TLO's task is to manage and document learning and disseminate knowledge from NUMMI to GM. From 1985 to 2003, the scope of the TLO expanded to incorporate a wide variety of training and knowledge transfer activities. More specifically, after 1992, significant changes were made in how the TLO supported learning. The TLO is staffed by a small number of full-time employees and, like NUMMI itself, has a group of 10-11 advisors on assignment from GM. These advisors have the same structured learning requirement as the advisors in NUMMI, although TLO advisors spent more time on teaching activities than advisors assigned to the plant.

The TLO is involved in both knowledge transfer from NUMMI to GM and knowledge change within GM. The TLO coordinates the multi-year advisor programs and other shorter visits, including the following:

- study teams focused on learning about a specific task (such as how to build doors), the TLO designs a learning experience of 3 days to 2 weeks, and teams must establish an implementation team and follow-up;
- short awareness visits and plant tours (1-2 days);
- short-term assignments (2 weeks);
- executive in residence (8 months), one executive at a time; and
- topical workshops (3-5 days) on topics such as recognition and rewards, which may be broadcast to other GM sites.

The TLO supports the documentation of TPS knowledge, which makes the knowledge more easily teachable and transferable. The TLO also performs training designed to educate GM managers about the potential impact the TPS could have on GM manufacturing. Finally, in recent years the TLO has expanded its activity base to include a consulting business primarily focused on NUMMI and GM suppliers.

Enhancements to the Advisor System

The creation of the TLO provided the foundation to enhance the selection, training, and deploying of advisors. With the appointment of a new TLO head in 1990, various changes were made to the advisor system to ensure that the advisors maximized their personal learning opportunity and to ensure that advisors were well armed for the knowledge transfer challenge they would face

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NUMMI and Greenfield Plants

NUMMI played a key role in the development of the Opel plant in Eisenach Germany. The Eisenach plant, which opened in 1992, was the first greenfield GM plant to institute TPS-based lean manufacturing. Some NUMMI alumni were involved in the startup. When Eisenach was conceived by GM Europe management, the objective was "to build a plant like NUMMI." Although many people in GM, especially in North America, said it could not be done, Eisenach was an outstanding success. Eisenach was also the most tangible initial evidence that GM was capable of implementing lean manufacturing. Eisenach became the model for a series of greenfield plants in Argentina (opened in 1997), China (1998), Poland (1998), and Thailand (2000). NUMMI also was the basis for a major turnaround effort in GM do Brasil, which preceded the Argentina plant development. As each international greenfield plant was built, lean production knowledge levels increased and the network of knowledge expanded. With each greenfield plant, the objective was greater manufacturing efficiency than the previous one.

A new core of lean manufacturing experts was created with each greenfield initiative, which increased the learning network. For example, the first plant manager in Argentina came from Eisenach where he had been operations manager for five years including during the startup. While Argentina was being developed in the mid-1990s, the plant manager was making 4-5 visits to NUMMI per year with a team of people. At another Latin American plant trying to become leaner, all the managers (7 employees), supervisors (20), and team leaders (35) visited NUMMI. A large number of Brazil managers were temporarily assigned to Argentina, many of whom had been to NUMMI and were familiar with lean manufacturing concepts. Most of the original team of managers involved in the Eisenach startup are still with GM and have played a key role in sharing lean manufacturing knowledge.

Within North America in the late 1990s, lean production began to influence all aspects of manufacturing. The most visible outcome of the lean manufacturing knowledge transfer in the United States in a greenfield plant is the Lansing Grand River plant opened in early 2002. The Lansing Grand River plant was built on the site of 19 demolished buildings that dated to Oldsmobile's earliest days at the turn of the last century. The plant cost \$559 million, about half what GM spent in the past on similarly sized plants and at 644,000 square feet, the plant is about half the size of a traditional assembly building. Lansing Grand River embodies many of the TPS-derived lean manufacturing ideas and builds on GM's experience with the international greenfield plants. The plant is a testament to GM's success at learning from NUMMI as well as the company's ability to innovate. A Technical Liaison Office at Lansing Grand River has been created to replicate the NUMMI TLO concept in a wholly owned GM facility.

From a broad base of learning that began with NUMMI and includes Eisenach and the other international greenfield plants, the CAMI joint venture with Suzuki, the relationship with Isuzu, and various other learning opportunities, GM has created its Global Manufacturing System (GMS), which is GM's lean manufacturing system being implemented on a worldwide basis. Plans are underway to use the TLO concept to create GMS learning centers in Asia, Europe, and Latin America.

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once they moved on from NUMMI. The changes were the result of trial-and-error and direct feedback from the experience of the earliest advisors. Unlike the early days of NUMMI when advisors were given little or no preparation for their assignment, the advisors selected today have clearly specified learning objectives and an educational plan. The main elements of the plans in 2003 were:

- Each advisor's learning experience is customized and is supported by a learning contract and a mentor in GM. This process is managed by the head of the TLO and requires regular follow-up with the mentor.
- A structured learning experience is created, with the learning centered around five elements: plant line assignments, learning from predecessor advisors, learning across different areas of the plant, networking with other NUMMI alumni, and learning to become teachers.
- Individual advisor learning is tailored and supervised using Personal Development Requirements (PDRs) tied to the advisors' expected re-entry assignment. The PDR is an educational tool that organizes learning activities in various stages: orientation to NUMMI and lean manufacturing; plant floor work; required training in areas such as standardized work, Japanese culture, and teaching; required reading of about 20 books on lean manufacturing, change management, and general management that must be read in sequence; individual learning (called "Take Time to Learn"); visits to other lean U.S. and international plants; and home unit visits. All training is coordinated through the TLO.
- Advisors are prepared in advance for their re-entry assignment in GM. In almost all cases, advisors have a clear expectation of the managerial position they will occupy once they return to GM. What this means is that advisors can focus on specific areas that will help them in their return assignment. (See the sidebar on the Orion Assembly Plant for an example of how one ex-NUMMI manager was able to affect change in a GM brownfield plant.)
- All advisors are required to write summaries of their learning experiences and implications for GM. These summaries, called White Papers, are then disseminated within GM.
- Senior executives from GM regularly visit NUMMI, which reinforces the importance of the advisor learning experience. The result of the systematic learning can be seen in the reaction from the outside labor market. By the late 1990s, managers trained at NUMMI became so attractive to outside employers that GM was forced to introduce financial penalties for managers who left GM within two years of their NUMMI assignment.

Changes to GM's Knowledge Base

The creation of the TLO and the changes to the advisor system were critical in ensuring that knowledge was identified, captured, and put into motion. However, the knowledge from NUMMI could not impact GM until it was combined with existing GM knowledge. For this to happen, GM managers would

have to acknowledge that the knowledge had value. However, many GM leaders in the late-1980s did not yet have deep understanding of why the knowledge was valuable and how it could be utilized by GM. In the absence of leadership understanding, knowledge transfer cannot have a strategic impact. As GM gained experience with NUMMI, GM leadership came to the realization that TPS-based knowledge was valuable. Several factors played a key role in helping shift the perception about how NUMMI could influence GM. These factors collectively supported changes to the GM knowledge base.

- *Visits and Plant Tours*—Initially, Toyota limited the number of visitors in NUMMI to five, not because of concerns about knowledge leakage but because of concerns that the plant's production would be disrupted. After this restriction was ended, the number of visitors increased significantly. Between 1984 and 1988 there were about 2,000 visitors. Between 1989 and 2003 there were about 21,000 visitors, including non-GM individuals and companies. Visits and tours were instrumental in exposing many, often skeptical, GM managers, engineers, plant workers, and union officials to the fundamentals of the TPS. While these visits do not allow visitors who are unfamiliar with the TPS to develop a real understanding of its systemic nature, the visits can generate new insights and awareness that would not be possible without firsthand exposure to the plant. It should also be emphasized that in the early years of NUMMI (1984-1990), the short visits had limited impact because there were few GM teachers who could explain the TPS. These visits did nothing to change the minds of head-in-the-sand GM managers who didn't want to learn. As the base of knowledge about the TPS expanded within the TLO, it was possible to provide a stronger learning experience for visitors.
- *Leadership Commitment and Involvement*—When NUMMI was first created, there was limited understanding about Japanese management practices in the U.S. auto industry and in U.S. industry in general. The measurable differences in Japanese automaker productivity and quality were known but the principles of lean manufacturing were only vaguely understood (and the term itself did not emerge until later). GM leadership in the early 1980s tended to downplay the Japanese competitive threat. However, as increasing numbers of managers and executives were exposed to NUMMI, GM leadership re-evaluated the learning opportunity. In addition, new leadership at GM recognized the competitive strength of the Japanese firms. The result was a more pragmatic approach to learning from Toyota. By the early 1990s, knowledge about TPS was being actively sought by automakers all over the world. GM's joint venture with Toyota provided an important advantage in knowledge access relative to its competitors. More importantly, many NUMMI alumni have moved on to senior positions and the ability to directly influence GM's manufacturing systems.
- *Learning Network*—About 240 advisors have been through NUMMI and as of 2003 about 170 were still working in GM in a variety of management

Change in a Brownfield Plant: The Orion Assembly Plant

In 1983, GM opened its Orion assembly plant in Orion Township on the I75 corridor in south Michigan. At the opening, the plant was described by GM as "the last word in automation, sophisticated manufacturing systems, and enlightened labor relations." By the late 1990s, Orion was one of GM's poorest performing plants with a myriad of problems: major labor unrest, chronic absenteeism, thousands of employee grievances, substandard quality, a local union agreement that was expensive and restrictive, occasional sabotage in the plant, and temporary plant shutdowns because of friction between the workers and the company. Labor and management relations were so bad that some hourly employees refused to even acknowledge salaried employees unless they were directly addressed.

In January 2001, Jamie Hresko became plant manager at Orion. Hresko, a native of Flint, Michigan, started with GM in a co-op program after high school. After finishing an engineering degree, he worked in a series of manufacturing positions, including a stint at the Orion plant. In 1997, Hresko was sponsored for an MBA at Stanford and when he finished, was asked to go to NUMMI. Initially, Hresko was not impressed with what he saw in the NUMMI plant. From his perspective, there did not appear to be a clear process being followed. To learn more, he got a job on the line and ended up staying there three months. He took the team leader course, was promoted to team leader, and had firsthand insight into how the TPS worked. "I was shocked to learn that the hourly people essentially ran the place. The success of NUMMI was largely due to the small team system." Like many other managers who experienced the TPS firsthand, Hresko's views about how to run a car plant were transformed.

In 1999, Hresko became an assistant plant manager at Lansing and was successful in implementing a team system modeled on the NUMMI approach. Hresko's success at Lansing resulted in his promotion to plant manager at Orion. When Hresko arrived at Orion in 2001, the implementation of GM's Global Manufacturing System (GMS) had already begun. Based on GM audits, the GMS implementation at the Orion plant was about 50% in 2001. However, many of the problems identified earlier still existed. For example, there were almost 1300 employee grievances in 2001 and the union relationship was terrible.

In addition to the establishment of small teams (1-7 ratio), the priority issues for implementation at Orion included *andon*, error proofing, the institutionalization of problem-solving training, and GMS training for all salaried employees. At first, the hourly employees were skeptical about the team system. As one employee who had worked in the plant since it opened said, "We laughed. We had heard it all before, starting in 1983. We figured it would last a few weeks and then disappear."

Hresko was determined to make Orion a lean operation and was passionate about building trust between management and the hourly employees. To implement the changes and get the hourly people more involved in running the plant, Hresko knew that he would have to eliminate all vestiges of GM's heritage of conflict and union-management strife. Hresko had the support of his boss and his direct reports in the plant. Lean manufacturing based on GM's Global Manufacturing System was being implemented throughout North America and results were starting to show up in various quality and productivity rankings. Nevertheless, the barriers to change at Orion were significant. The team concept requires team leaders, which means

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some hourly employees have to take on greater responsibilities. Initially, few employees wanted to be team leaders because that was seen as "sucking up to management and they were the enemy." To some salaried employees the team concept meant giving up control to hourly workers who, it was assumed, were not qualified to make decisions. The team concept also requires the managers to work with the hourly employees more as partners and less as subordinates. The union leadership saw the team concept as a way to reduce employment and did not understand that in the increasingly competitive automotive environment, lean meant survival. To the skilled trades workers, such as those in maintenance, the team concept looked threatening because it meant teams would have greater responsibility for their own worksites. It also probably looked like just another attempt by GM to benefit the corporation at workers' expense. Finally, perhaps the biggest barrier to change was the history in the plant and the lack of trust between management and hourly workers.

To implement change, Hresko and his managers focused on communication and training. Although some people were resistant to any changes, the main emphasis of the implementation program was working with people to convince them that GM had to become leaner in order to compete. "The only way we could improve performance was if management and the union worked together. Eventually the union came to understand the realities of the competitive environment, something that could never have happened in the past." A new plant union leader was elected and he has proved to be instrumental in enabling the implementation of lean ideas. There were some managers that could not work in the new environment and had to be let go. New training programs were launched, including an outdoor team-building exercise called Buzzard Ridge on the plant property.

Over the next three years the plant went through remarkable change. Significant improvements occurred in safety, the number of grievances (less than 50 in 2003), participation in the suggestion program (from 55% participation to 85% participation), GM audit problems per vehicle and JD Power problems per vehicle, warranty incidents per vehicle, and hours per vehicle. The 2003 JD Power North American plant ranking based on customer reported problems ranked Orion number 6 out of North American plants (#21 in 2002). According to Hresko, "The healing stage is over and the plant is now one of the best plants in GM." As evidence of the improvements, the Orion plant was chosen to build the new Pontiac G6, which was launched in 2004. To convert the plant body shop for the new product, Hresko decided to take a significant risk and rely much more on his own employees and less on outside contractors. At first, his bosses were leery: their view was that hourly people did not have the skills. Hresko persisted with the plan and was able to save the company millions of dollars. He also built a base of knowledge and was able to involve the skilled trades employees to a high level.

positions. There is unanimous agreement among the advisors that their personal NUMMI experience was a pivotal point in their careers. Shorter-term visitors to NUMMI also indicated that their experiences were extremely valuable. Linking the various personal experiences of the advisors and all GM employees who have had contact with NUMMI is a constantly growing network of employees who have a range of understanding about the TPS. This network continues to play a key role in

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spreading knowledge and ensuring that the recipient units understood why NUMMI is used as a model for GM. Until the network had sufficient critical mass, changing the traditional knowledge base at GM was bound to be difficult. According to a former head of the TLO:

"There was definitely not a critical mass by 1990. In my view, a critical mass was reached when Jack Smith became CEO [in 1992]. Jack Smith promoted people with NUMMI experience and made it clear that he was a supporter of lean manufacturing. With the previous top management, it was not a great thing to have on your resume that you had worked at NUMMI."

Social network researchers use the term "network effects" to describe the process whereby individuals in a social network converge in their views and behaviors to the extent that they have exposure to other people in the network.¹⁴ As more and more GM managers became exposed to NUMMI and as some of these managers eventually moved to senior manager positions, the initially disorganized pattern of learning from NUMMI began to shift to a more systematic approach as the NUMMI "followers" (i.e., those that had been exposed to NUMMI and believed in the learning opportunity) interacted and shared their views. For example, consider the comment from a manager who was at NUMMI in the mid-1980s:

"We were making inroads but it took time to convince the leadership. In 1990, four of us from NUMMI got the leadership to agree to let us use the concepts in teaching. We designed a workshop where we focused on waste and integrated into it concepts of TPS. We got plant leaders to teach and we facilitated. The workshops snowballed and took off; we realized that we had to grow the knowledge."

The network of former NUMMI advisors is managed informally rather than formally. The head of the TLO keeps in touch with NUMMI alumni and actively follows their career progress. Also, given that securing a NUMMI advisor position is now quite competitive within GM and TPS knowledge is willingly embraced, the NUMMI alumni network now occupies a more visible role in the firm.

Facilitating Factors and the Learning Process

There are several factors that facilitated effective learning and knowledge transfer at GM.¹⁵ First, the company's initial learning objectives had to be significantly modified before effective learning could occur. The firm's willingness to adjust the learning objectives over the life of the alliance was an important ingredient in ensuring that the learning process focused on the most valuable knowledge. GM's initial efforts at learning were narrowly applied and, as noted, there was a belief that TPS knowledge was observable and easily transportable. Also, there was an expectation that the learning would happen quite rapidly. Over time, as the magnitude and complexity of the learning opportunity became clearer, GM instituted the various learning processes described above.

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GM's willingness to modify its learning objectives is related to a second facilitating factor. GM's learning processes collectively allowed redundancy to be built into the learning process. Redundancy means the conscious overlapping of company information, activities, and management responsibilities.¹⁶ Redundancy encourages frequent dialogue and, as Peter Senge argued, dialogue is a key element of collective learning.¹⁷ In a dialogue, complex issues are explored with the objective of collectively achieving common meaning. Dialogue involves conversations and connections between people at different organization levels. Inevitably, as issues are debated and assumptions questioned, dialogue will lead to some redundancy in information. Without a tolerance for redundancy, sharing of ideas and effective dialogue will be difficult. The learning system built by GM, and especially the TLO's contribution, is representative of necessary redundancy. Initially, there were few GM employees with the necessary skills in lean management to appreciate the NUMMI learning opportunity and there was limited interest in NUMMI dialog that went "beyond the immediate operational requirements of organizational members."¹⁸ (Few GM executive were interested in hearing about why NUMMI was outperforming GM plants and how the reasons for this performance gap could help GM.) As the TLO developed its learning mechanisms and, in particular, as the advisor system was developed, dialog about NUMMI began and eventually escalated to the top of the company. For example, managers who returned to GM from NUMMI were expected to become teachers to other GM employees. The short-term visits to NUMMI for GM employees always incorporated an opportunity in the TLO for critical discussion.

A third factor is the climate of trust between GM and Toyota and between NUMMI and the GM organization. This trust was critical to the free exchange of information (see sidebar on Toyota's willingness to share knowledge). Finally, top management's role was an important facilitator. When NUMMI began, some GM top management people were skeptical as to the learning opportunity and few understood the potential impact if learning could be harnessed. Eventually, the top management role in the learning process evolved into one of catalyst and architect.

Overcoming the Learning Obstacles

GM had to overcome all of the five obstacles identified earlier. In doing so, the three facilitating factors supported the development of a learning system that has played a key role in strengthening GM's product quality and manufacturing productivity. Exhibit 2 summarizes the GM actions that helped overcome the obstacles and that have become key elements of the on-going knowledge transfer and learning process.

The results of this study are consistent with research in the learning transfer area.¹⁹ Successful knowledge transfer and learning will not occur until the organization has the capacity to learn and the requisite mechanisms in place to facilitate knowledge transfer and knowledge assimilation. Within GM, there was

Toyota's Willingness to Share knowledge

For many observers of NUMMI, Toyota's willingness to share its valuable TPS knowledge with GM has always been somewhat of a puzzle. I have been asked the following question many times: "Now that Toyota has its own plants in North America, why does the firm continue to share knowledge with a competitor?" Yes, GM and Toyota are major competitors on a global basis and Toyota has extensive wholly owned operations in Kentucky, Indiana, Ontario, and elsewhere. Nevertheless, there are several reasons why Toyota remains a partner with GM and, in doing so, provides a unique and valuable learning opportunity for GM. First, GM and Toyota, despite being competitors, have a strong partnership with senior management support on both sides. Perhaps more so for Toyota, given its Japanese roots, there is the view that partnerships that endure for many years with no obvious problems should be maintained and supported. Moreover, in typical Japanese corporate fashion, close partners usually share information. Second, Toyota has always been proud of its manufacturing leadership position and has openly shared the TPS with outsiders. Among the many books written on lean manufacturing are a number by Taiichi Ohno, the Toyota executive who, along with Shigeo Shingo, developed the principles underlying the TPS. Ohno wrote "Toyota Production System: Beyond Large-Scale Production" when he was an executive vice president at Toyota. Third, although Toyota has shared aspects of the TPS, Toyota has proprietary engineering and manufacturing processes that are not accessible via the partnership (as does GM). In other words, Toyota is not giving away all of its crown jewels. Fourth, learning in NUMMI goes both ways: Toyota has learned and continues to learn from GM. GM has played a key role in the management of NUMMI and has contributed critical knowledge in areas such as plant safety, materials handling, and workforce management. The NUMMI plant manager during the complex introduction of several new models in 2001-2002 was from GM, not Toyota. Finally, from a public relations perspective, Toyota's choice to remain a loyal GM partner is probably a wise one given the highly politicized nature of the U.S. automobile industry.

outright resistance to learning in 1984. Once the resistance was eradicated, there was a need to create a sustainable learning process. The TLO was established early because there was a desire to learn. However, the first 8-10 years were filled with a variety of mistakes and missteps, lack of the proper systems in place, and the need to eradicate the Not Invented Here Syndrome.

Lessons From the GM Experience

From this case study, several further lessons can be drawn for other firms seeking to exploit learning and knowledge transfer opportunities:

- *Successful organizational knowledge transfer requires both moving the knowledge and changing the recipient's knowledge.* The individuals moved from NUMMI to GM possessed unique ideas but both the attempts to codify the ideas into principles and the usefulness of the codification encountered barriers, mainly from individuals with limited exposure and understanding of the TPS system. Until GM knowledge was changed, or modified, and

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EXHIBIT 2. Learning Obstacles and GM Actions

Learning Obstacle	GM Actions that Helped Overcome the Obstacles
Causal Ambiguity	Training; visits to NUMMI by GM and supplier employees; sharing of information facilitated by the TLO; creation of a network of NUMMI-experienced managers; direct involvement of GM leadership; and time (about eight years before real learning began).
Lack of Leadership Commitment to Learning	Jack Smith appointed CEO in 1992; former NUMMI advisors promoted within GM; GM leaders develop an understanding of lean production.
Unwillingness to Invest in Learning	Expansion of the scope of the TLO's mandate to encompass a broad set of learning activities; replication of the TLO for several GM plants.
Failure to Build a System that Captures the Learning of Individual Managers	Development of the advisor system (personal development requirements; GM mentors, planned re-entry assignments, etc.); learning network of NUMMI alumni; NUMMI assignments became recognized within GM as important and desirable developmental experiences.
Not Invented Here Syndrome	Learning network; experience with lean manufacturing in NUMMI; Eisenach and other plants; superior performance within NUMMI relative to other GM plants.

combined with knowledge from NUMMI, the knowledge transfer was destined to remain minimal.²⁰ To change the knowledge held by the GM organization, extensive communication had to occur between individuals with an understanding of NUMMI and the groups that were responsible for manufacturing. The change occurred via training, visits to NUMMI, sharing of information, creation of a network of NUMMI-experienced managers, and direct involvement of GM leadership. The most important knowledge that had to be changed was that possessed by the firm's leadership. When NUMMI was formed, GM leadership had a very limited understanding of the learning potential and some of the leaders were openly opposed to collaboration with Toyota. Until these leaders's views changed, or the leaders themselves were replaced, knowledge transfer could not have a strategic impact. Fortunately for GM, three things happened. First, a core group of middle managers who embraced NUMMI ideas became senior executives within GM. Second, Jack Smith became committed to NUMMI and lean manufacturing in the mid-1980s and was able to have a strong influence on other firm leaders. Third, GM leaders embraced the notion, adapted from Toyota, that effective leaders have to know the system and they have to be able to teach it.

GM has ensured that the TPS principles are adapted to the GM context, which differs in significant ways from Toyota's. For example, changes at GM must involve the United Auto Workers whereas Toyota's plants are non-unionized. By adapting the TPS, GM has allowed the organization to maintain its own identity and develop what GM calls its Global Manufacturing System (GMS). GMS was designed to transform

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multiple ways of manufacturing into a single method. The principles are directly adapted from the TPS: people involvement, built-in-quality, standardization, continuous improvement, and short lead times. Commonality of process is key to GMS, coupled with a global vehicle architecture strategy and an emphasis on putting flexible manufacturing tools in the plants.²¹

- *Knowledge transfer effectiveness can be actively managed and improved upon.* Although many firms strive to become learning organizations, the reality is that few actually understand how to create the type of managerial processes that can effectively transfer knowledge between and among organizational units. In the alliance context, it is unrealistic to expect that knowledge transfer will happen just because individuals are exposed to new knowledge. As GM discovered, until a learning infrastructure was in place, efforts to transfer knowledge generated only sporadic positive results. As an effective knowledge transfer system emerged, GM recognized the importance of active intervention and purposefully created organizational mechanisms to capitalize on the NUMMI learning opportunities. The mechanisms include the advisor system, the TLO, and the use of greenfield plants to showcase lean manufacturing.
- *Learning requires experimentation and innovation.* To some observers, GM's long involvement in NUMMI is evidence that GM has not been very successful in learning from NUMMI. Why, ask the skeptics, has it taken GM 20 years to learn from NUMMI? There is no question that, in retrospect, GM made numerous mistakes in trying to learn from NUMMI and did not exploit an opportunity to gain a significant first-mover advantage via early exposure to the TPS. The years 1984-1992 were not as productive from a learning perspective as they could have been because many GM leaders discounted the learning opportunity, NUMMI advisors were not properly prepared for their assignment and GM re-entry, GM did not initially understand the underlying principles of the TPS, and so on. As a result, learning began at a very slow rate and almost a decade of valuable time was lost. During that decade, many of GM's senior managers were unable to understand the value of the TPS knowledge and unwilling to develop the understanding.

As GM gained experience in the joint venture, corrected some early mistakes, replaced the leadership, and developed a knowledge transfer system, learning was able to occur. More importantly, the learning did not stop and is still happening two decades later. In addition, it took some time to get a knowledge transfer system in place. According to a GM manager, "We had NUMMI, but we had to experiment as to how to exploit the learning opportunity." For the small number of managers that initially saw a valuable learning opportunity in 1984, there was no template that could be applied to the NUMMI situation. The knowledge transfer processes that emerged had to be invented by GM. In retrospect, some of the processes, such as ensuring that advisors were properly

selected for NUMMI and adequately prepared for re-entry to GM, are quite obvious and GM rightfully deserves to be criticized for not implementing them earlier. However, given the lack of understanding that existed about the TPS before the venture was formed, some early mistakes in creating a knowledge transfer system were inevitable. Experimentation and a willingness to persevere through the early days of the venture ultimately resulted in valuable learning (albeit, one can only speculate as to where GM might be if significant knowledge transfer had been initiated much earlier).

Other firms trying to exploit an alliance learning opportunity should not be scared off by the challenges of successfully capturing alliance knowledge. Many of the knowledge transfer mechanisms used by GM can be quickly implemented if there is a clear understanding of the learning objective and if the barriers to learning can be overcome. Moreover, as GM's experience shows, a willingness to invest resources in developing an innovative knowledge transfer system can yield results that go far beyond a one-way transfer of knowledge from alliance to parent. Learning should not be viewed as a discrete outcome, but as an ongoing process.

- *Knowledge transfer is all about ties between people.* All too often, firms assume that organizational knowledge can be managed by establishing databases of factual information that can be digitally stored and accessed by people throughout the organization. There is no doubt that some knowledge can be reduced to digitized form and easily transferred within an organization. However, complex knowledge with real strategic value must be managed and transferred through social networks, not computer networks. One of the key lessons is the value of social learning networks and the need to actively build, nurture, and replicate the networks throughout the organization. GM's decision to replicate the TLO concept in various locations is an indicator of the commitment to building knowledge ties between various parts of the organization. Moreover, GM's learning success is, in large part, due to the initiative of middle management personnel. This suggests that other companies seeking to exploit alliance learning objectives should put the best people possible into the network, provide the infrastructure to support that network, and promote the "learning-enabled managers" to positions of leadership.
- *The learning value of most alliances is usually greater than managers understand and appreciate when alliances are new and recently formed.* When alliances are in the formation process, the emphasis of the partners is usually on issues such as compatibility, commitment, and convergence of partner interests. Learning opportunities are relegated to a secondary position, or they are completely ignored in the interests of closing the deal and making the alliance an operating entity. Alliances will almost always create learning opportunities. The real issue is knowing what they are and creating an environment where they can be exploited. With NUMMI, the most significant impact on GM performance has been in the areas of manufacturing

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productivity and quality. NUMMI also has played a key role in GM's international greenfield expansion, in training managers in areas such as repair and plant management, and, perhaps most importantly, in providing critical understanding of Toyota as a competitive threat.

To properly assess the learning value of alliances, firms must have a solid grasp of what they know (and don't know). Fortunately, NUMMI has lasted long enough to allow GM to develop a critical sense of the value of learning. In contrast, many alliances are short-lived and by the time a learning opportunity is identified, the alliance is on its last legs. Thus, an early assessment of learning opportunities is essential.

- *Knowledge must be leveraged across the organization to generate real returns.* As knowledge gets transferred and put into use, its value increases and the network of knowledge also expands, which creates further opportunities to exploit the value of the knowledge. From an initial starting point of a few advisors in NUMMI, GM built a network of knowledgeable managers, engineers, union officials, suppliers, and line workers who each became nodes in the knowledge network. As each individual connected with new people, the network expanded, increasing the penetration of the valuable knowledge. The result is that GM is a stronger organization that has developed a learning capacity and an understanding of how to transfer and exploit knowledge.

APPENDIX

Research Methodology

The majority of data was collected via interview with GM managers. Interviews were conducted in person and via telephone. Site visits were conducted at NUMMI, the NUMMI Technical Liaison Office, GM Argentina in Buenos Aires, and GM plants in Rosario and Cordoba, Argentina and Orion Township, Michigan. In total, more than 45 current or former GM managers were interviewed along with several outside observers and a number of hourly employees. The GM managers came from various backgrounds; the common thread was a connection to NUMMI and the knowledge transferred from the joint venture to GM. I interviewed some of the original GM managers assigned to NUMMI, managers who worked at NUMMI during the period 1984-2002, and managers on assignment in NUMMI in 2002. I also interviewed current and former GM plant managers and corporate managers involved in various aspects of manufacturing and quality. Data were collected in Argentina because Argentina was one of the sites for a greenfield plant using knowledge transferred from NUMMI. In conducting the interviews, I learned that there was a network of managers within GM that shared a NUMMI connection and that fervently believed in the NUMMI's value as a learning opportunity for GM. I also consulted published reports on NUMMI and some internal GM documents written when NUMMI was formed. The published reports helped establish the historical context for the joint venture.

Interview questions depended on the respondent's experience. For respondents who had worked in NUMMI, I focused on three main areas: the respondent's personal history in GM and NUMMI; the impact NUMMI had on the respondent's career in GM; and the impact their NUMMI experience had on GM. For other respondents, I was interested in their assessment of the impact NUMMI had on GM and how that impact had been managed. For all respondents, I asked: "What is (or was) your involvement with NUMMI" and "How has NUMMI impacted GM?" There was a high degree of consensus among the GM interviewees.

Notes

1. The alliance literature dealing with learning and knowledge transfer is extensive. For example, see A.C. Inkpen and A. Dinur, "Knowledge Management Processes and International Joint Ventures," *Organization Science*, 9/4 (1998): 454-468; R.D. Ireland, M.A. Hitt, and D. Vaidyanath, "Alliance Management as a Source of Competitive Advantage," *Journal of Management*, 28/3 (2002): 413-446; T. Khanna, R. Gulati, and N. Nohria, "The Dynamics of Learning Alliances: Competition, Cooperation, and Relative Scope," *Strategic Management Journal*, 19/3 (1998): 193-210.
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9. For a discussion of personnel movement and knowledge management, see W.J. Orlikowski, "Knowing in Practice: Enacting a Collective Capability in Distributed Organizing," *Organization Science*, 13/3 (2002): 249-273.
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11. P.S. Adler and R.E. Cole, "Designed for Learning: A Tale of Two Auto Plants," *Sloan Management Review*, 34/3 (Spring 1993): 85-94.
12. For a discussion of the NUMMI production system, see P.S. Adler, "The 'Learning Bureaucracy': New United Motor Manufacturing, Inc.," in B.M. Staw and L.L. Cummings, eds., *Research in Organizational Behavior*, Volume 15 (Greenwich, CT: JAI Press, 1993), pp. 111-194.
13. The element of the TPS that GM did not initially understand has been called the DNA. See S. Spear and H.K. Bowen, "Decoding the DNA of the Toyota Production System," *Harvard Business Review*, 77/5 (1999): 96-106.
14. For a more complete discussion of network effects, see P.V. Marsden and N. Friedkin, "Network Studies on Social Influence," in S. Wasserman and J. Galaskiewicz, eds., *Advance in Social Network Analysis* (Thousand Oaks, CA: Sage, 1994), pp. 3-25; J.C. Pastor, J. Meindl, and M. Mayo, "A Network Effects Model of Charisma Attributions," *Academy of Management Journal*, 45/2 (2002): 410-420.
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19. For example, see G. Szulanski, "Exploring Internal Stickiness: Impediments to the Transfer of Best Practice Within the Firm," *Strategic Management Journal*, 17 (Winter 1996): 27-43. Basing his article on a study of intracorporate, inter-divisional transfer of best practices, Szulanski found that three key factors were most important in contributing to knowledge stickiness (i.e., difficulty in transfer): causal ambiguity, lack of absorptive capacity of the recipient, and the relationship between the source and recipient. Causal ambiguity, which is a characteristic of the knowledge transferred, was a major obstacle for GM that took years to overcome. A lack of absorptive capacity means that the recipient is unable to assimilate and apply new knowledge. In GM's case, once there was an understanding of the relationship between the various TPS principles and plant performance, there remained the challenge of convincing the parent managers and executives that this knowledge should be assimilated and disseminated across the entire organization. The factor involving the source-recipient relationship can be seen in the Not Invented Here Syndrome (i.e., "Why should we try to learn from them?") and also the difficulty that NUMMI advisors had on their re-entry to GM. I also found that leadership commitment and the cost of learning were obstacles that had to be overcome, which is consistent with lack of recipient motivation in Szulanski's terminology (which Szulanski did not find to be significant in his study).
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